

Interactive use is almost completely prevented with the current proposal.

DemoGraFX believes in the need for standardization of our national ATV system, but disagrees with the commission's belief that the ACATS proposal provides the needed benefits.

3.12. Detailed Comments on Previous Statements (Paragraph 22 of the Notice)

This paragraph explores a key issue facing the commission. The issue is how to go about deploying a national ATV system without foreclosing future innovation. The paragraph questions the need for mandatory standards. However, DemoGraFX feels that at least the modulation, error correction, packetization and base layer of image and audio must be standardized. Without such standardization, there would be no guarantee that receivers could be made which would operate nationwide. This is clearly pointed out by the commission in other portions of the notice.

The issue of not foreclosing innovation is crucial, especially in light of the rapid pace of development of digital technology within the computer industry (Moore's Law). A key step was taken by the commission in 1991 with the "simulcast" decision. It would be very difficult to innovate and to add new features to the existing NTSC signal, which is so very wasteful of bandwidth in light of modern available technology. Thus, innovation to NTSC of any significance, as suggested in this paragraph, is not really feasible. The "base layer" technology of NTSC is unsuited to such innovation. It could be viewed that NTSC, in the way that it formats the video picture, and the way that it occupies the 6 MHz television channel, effectively precludes significant or substantial innovation or improvement. Thus, the simulcast decision was the correct one. A new signal structure is required before innovation will be feasible.

However, no amount of moving mandatory standards regarding NTSC to voluntary ones could fix NTSC's effective block toward significant innovation. It is the same with the ATV standard, once the basic structure of the television standard is defined, it also will define the degree to which innovation will be possible or prevented. The ACATS proposal sets up a structure where the potential for such innovation is limited.

The more correct structure would be to develop a layered system, such as the one we have developed, and place it upon a data and packet layer which is suitably error-free and extensible. With such a structure, the base layer for picture, audio, and data, form the "bed rock" ground that allows every receiver manufacturer, and computer manufacturer to make receivers which reliably operate nationally. Innovation is then possible utilizing the bits above the base layer for enhancements. The DemoGraFX enhancement layer is only one such potential innovation, yet it provides all of the capabilities of the "migration to full progressive" right now.

Thus, the base layer should have limited flexibility, and should be standardized within limited tolerances, so that receivers can be assured of reliable reception regardless of location within the nation. The enhancement layer(s), however, should be as flexible as is allowed by the digital potential within cost-effective decoders. The more flexibility in enhancement, the more room for innovation. Yet such innovation would not hinder the installed receiver base, since all receivers can decode the base layer.

Thus the key mechanisms to enable innovation within the data stream are a flexible header system, the capability for error-free delivery of data and headers, and a layered architecture for picture and audio. Issues such as whether standards are mandatory or voluntary, time limits on standards, or protecting portions of the data, are not central to the issue of providing for innovation.

The ability to provide for innovation lies primarily in the specifics of the ATV standard. The ACATS proposal does not provide for much innovation potential due to its weak header, its lack of error-free data, and the non-layered 18 format architecture. Interlace further burdens the potential for innovation, since layering upon interlaced formats is very inefficient compared to non-interlaced base layers.

3.13. Detailed Comments on The Second Inquiry (Paragraphs 23 through 26 of the Notice)

Paragraph 23 asks "whether it would be desirable to require compatibility between advanced television broadcast transmission and other ATV distribution media." This is a very relevant question. It appears to be the case that the digital broadcasting standard will also become the digital television standard for cable, satellite, digital tape, digital video disk, and other media. For this reason, the criteria for considering the ACATS proposal should be viewed in this broader context. The commission will be setting the standard for the entire nation, not just for televisions which attached to roof antennae.

Paragraph 23 comments as follows: "we believe that the public interest compels a Commission role in the development of standards with the advice and involvement of all sectors of industry". Based upon this statement, the commission should be open to comments being made by the computer and creative production communities which are dissenting with the ACATS proposal. Although there was attempt to participate in the work of ACATS, the ACATS work proved closed to outsiders from industries other than the primarily broadcasting and consumer electronics industries which were the bulk of participants. Once the systems switched to digital proposals in 1992, the participation and approval of the computer industry should have been ensured. The dissent now evidenced by CICATS and by the production creative community are evidence that these key industries were not involved in decisions, and that their advice was not acted upon.

The final sentence states " In this regard, we asserted that establishing a standard has certain advantages such as pointing the various interested parties in the same direction, reducing the risk to both audiences and broadcasters of investments in systems that might become obsolete if a different system is introduced into the market, and overcoming reluctance to invest in new equipment"

DemoGraFX fundamentally agrees with this viewpoint. However, the selection of a standard which is less than optimal, and which is computer incompatible, as is ACATS, will almost certainly remove the stated advantages of standardization. We feel that if the commission standardizes on the computer-incompatible ACATS proposal, that one or more separate computer-compatible standards will develop wherever the commission does not have jurisdiction. Thus, the reluctance to invest in new equipment, the industry movement in the same direction, and the reduction of risk to audiences and broadcasters in their investments will most likely be sacrificed by ACATS adoption. The notion of this sentence relies upon the commission selecting a correct and forward-looking standard. The backward-looking ACATS standard would be avoided by many who find it problematic, and industry would likely find ways to circumvent the ACATS standard wherever it was possible.

The issues raised in paragraph 24 were discussed in section 3.12 above concerning paragraph 22 of the notice.

Paragraph 25 of the Notice states "Most commenting parties supported the adoption of a single, mandatory terrestrial broadcast advanced television standard. Note that in footnote 22, those commenting in this way did not include computer companies or representatives of the production creative community. The computer industry's perspective favors extensibility, interoperability, and scalability over a "single" ATV standard. Certainly the 18 formats proposed

by ACATS could not be considered to be the intended result being recommended by these commenters in 1988.

Thus, the context and specifics of developing an appropriate ATV system for our nation are very different in 1996 than they were in 1988. No one foresaw digital systems in 1988, much less the details within the current ACATS proposal.

The comments of the FTC and of GTE raise the crucial issue, that adopting a single mandatory standard "could have the result of denying users better technology and services or running the risk of selection of the wrong standard". This is certainly the situation which the commission is facing with the present Notice.

At the end of paragraph 25, the notice states "Equipment manufacturers opposed a standard of limited duration because, they stated, it would leave the future unpredictable and would send a strong signal that broadcast and receiver equipment designed to that standard would become obsolete". In the fast paced digital era, this concern is very real, even if a standard is mandated. Obsolescence will not be stopped by mandating a permanent standard.

The notion of a "flexible" standard to defeat the force of obsolescence has some merit, but a more complete conception of the issue is embodied in "interoperability, scalability, and extensibility". The ACATS proposal does not embody these concepts beyond a simplistic level, and therefore the ACATS system is likely to be obsolete before it is even deployed. This is evidenced, for example, by a comparison with our system.

It is certainly appropriate that the commission states "we believe that recent developments warrant revisiting these issues".

In paragraph 26, the commission's 1990 simulcast decision is referenced. DemoGraFX applauds that decision.

The FCC's stated intention to select an ATV standard by the second quarter of 1993 is clearly irrelevant at the present time in mid-1996.

3.14. Detailed Comments on Recent Developments (Paragraphs 27 through 28 of the Notice)

In paragraph 27, the commission describes the ACATS proposal as a "single consensus standard". Although a consensus may have formed within the broadcast and consumer electronics industries who participated in ACATS, the consensus, support, and agreement with the ACATS work extends no further. Clearly there is no consensus among other industries concerning this standard. Consensus with the computer industry should have been a mandatory requirement subsequent to the switching of all of the proposals to being fully digital in 1992. Without computer industry consensus, there is no broad industry consensus concerning the ACATS proposed standard.

Paragraph 27 goes on to assert: "Today, only one systems has been recommended by our Advisory Committee and no other competing technology appears to demonstrate superiority over the ATSC DTV Standard. Thus, to the extent that concerns with the possibility of multiple competing systems were decisive in our earlier decisions, they may be less relevant today".

Clearly these comments assume that the DemoGraFX system is inferior to the ATSC DTV proposed Standard. DemoGraFX would like to demonstrate the superiority of our system by demonstration and independent analysis. Further, DemoGraFX would like to compete with the ACATS proposed system on image performance and spectrum efficiency, as well as on computer compatibility, and receiver cost. Thus, we assert that the commission is facing competing

systems, even though the DemoGraFX work was revealed subsequent to the disbanding of the ACATS committee. DemoGraFX again extends our invitation to the commission to see our system demonstrated.

In paragraph 28, the commission states "Today's digital technologies and improved compression techniques create the opportunity for delivering one, and under special circumstances perhaps two, HDTV program streams, or multiple program streams at lower resolution." DemoGraFX asserts that with our layered MPEG-2 system, that two or three HDTV movie programs made on film (at 24fps) would fit within the available 19.3 mbps. Although the entire 18.5 mbits available for video is used up by high frame rate sports coverage at the highest format (2k x 1k @ 72 Hz), film-based programming should always yield at least two HDTV programs within the available bit rate. Thus, the "special circumstances" required for ACATS system proposal are a limitation which is removed by DemoGraFX ATV system. Note that approximately 80% of prime time television is made on film. DemoGraFX also offers multiple programs at lower resolution, but provides these without interlace, unlike the ACATS proposed SDTV interlace-inclusive formats.

The commission goes on to state: "Furthermore, digital technologies give each licensee the technical capacity to explore new business opportunities and provide new services". DemoGraFX has commented above in section 3.9 concerning paragraph 19 of the Notice regarding the lack of error-free data delivery and the limited packet headers. These weaknesses of the ACATS proposal greatly limit its potential for new services and new business opportunities.

At the end of paragraph 28, the Notice states " If the ATSC DTV Standard is as dynamic as believed, a required standard will not thwart technical advance. Nevertheless, the inherently unforeseeable nature of innovation makes it impossible to predict the extent to which a required standard might affect future technological advances"

As is pointed out in detail within these comments, the ATSC DTV Standard is very limited in its capabilities and is very limited in its potential for extensibility. A more appropriate standard, however, would provide the benefits of extensibility.

DemoGraFX feels that the ATV standard should be a required standard, but that it should not be the future-limiting ACATS proposed ATSC DTV Standard

3.15. Detailed Comments on The Role of the Commission in Setting Standards (Paragraphs 29 through 30 of the Notice)

Again in paragraph 29 of the Notice, the commission states: "Critics of compulsory standards cite the cost of potentially freezing the state of the art, erecting barriers to technological innovation, and limiting competition in the television equipment business". DemoGraFX believes that adoption of the ACATS proposal will yield all of these drawbacks. The flaw lies not in compulsory standards, but in the lack of interoperability, scalability, and extensibility within the ACATS proposed ATV system.

Without computer interoperability, temporal and resolution scalability and adequate means for extensibility, the current proposed standard does not provide "consumer benefits, certainty and a smooth introduction of digital television encouraging innovation and promoting competition." Computer interoperability would greatly enhance the benefits to the consumer. Interoperability would provide for additional services in the home that are, under the present proposal, impossible to provide. Home Banking alone, would necessitate better text readability and most importantly a much lower error rate than is provided by the current standard. Consumers would also benefit greatly by scalability. A proper approach to scalability could reduce the consumer price of a video receiver by many hundreds of dollars. Finally, extensibility is paramount in the

rapidly accelerating computer and video technical environment of today. DemoGraFX has already demonstrated MPEG compression that is over two times that of the current standard, and with much quicker recovery from artifacts caused by stressful material. Yet, the current proposal would not allow for the standard to accomodate this innovation.

Paragraph 30 of the notice states "Besen and Johnson assert that the most constructive role a government agency can play in the standard setting process is to ratify standards agreed upon through private action when differences among alternatives are small." This is very true, however, in the case of this proposal the differences between alternatives is quite large. The proposal as it stands will literally cost consumers billions of dollars over a more scalable, extensible system without interlace. In the same paragraph, it is noted that "the Advisory Committee has served as a catalyst for focusing and coordinating the efforts of private industry." This too, is partially true. However, the private industry that has been focused is that of foreign based consumer electronics manufacturers and already deeply ensconced broadcasters. The computer industry has little representation and the balance of power on the Advisory Committee is heavily tilted toward European and Asian consumer electronics companies, and away from American industries and corporations. Artists such as Cinematographers, and Directors are not represented at all. It is no wonder that the proposal favors outmoded techonolgies such as monitors whose scan rate is clocked to the cycles of the power supply and to interlace. These technologies are heavily used already in foreign based consumer electronic products, but have been abandoned as antiquated and inadequate by the computer industry. New technologies have advanced display technology well beyond the limited recommendations of ACATS and the ATSC. Although the Advisory Committee claims to have "provided a forum for addressing and responding to the concerns of a wide array of interests", both the computer industry and the artist community have often found the forum to be closed and exclusionary.

3.16. Detailed Comments on Analysis of Required Standards (Paragraphs 31 through 36 of the Notice)

Paragraph 31 talks of the two traditional conditions that a standard should meet. The first, to provide a substantial public benefit and the second, to coalesce an industry that has several proposed standards around a single standard. The first condition of course is only met if the standard is the correct one. A standard that may cost consumers' billions of dollars and may greatly increase the current trade deficit can hardly be looked upon as a benefit to the American public. The second condition has not been met at all. What "industry" has strongly coalesced around the ATSC DTV Standard? The "industry" that is spoken of certainly does not pertain to the computer industry, nor to the Entertainment/Production industries that are made up of the artists whose vision brings the images to the consumer. These industries are strongly opposing the proposed standard. A single standard does "guarantee compatibility", but the current proposal, with eighteen separate standards, does not assure "consumers that the DTV equipment they purchase to view one television station can be used to view every other television station." In fact, each consumer receiver would have to be able to decode all eighteen separate standards in order for compatablity with every television station. Furthermore, this would not "reduce consumer costs by eliminating the need to purchase duplicate equipment or special devices to convert from one standard to another" but instead mandates the expense of every receiver having to have these standard converters built in to their electronics. Finally, compatibility with computer equipment is non-existent and therefore still more converters would have to be added to the receiver for computer interoperability. Each conversion would add the possibility of the degradation of image quality.

Paragraph 33 states our DemoGraFX' concerns quite well. It is paramount to recognize the novelty and fluidity of the technology and to determine how any specific approach to standards might impede further advances. It is the contention of DemoGraFX that the current proposed

standard is not extensible and items such as interlace and the proposed display rates will in fact block further advances toward a superior Advanced Television system.

Paragraph 34 bemoans the lack of innovation under the NTSC standard. Only a few improvements have been made over the years. The last important improvement was made a decade ago (stereo sound). This is very true, yet the computer industry in this last ten year period has totally moved away from interlace and 60 Hz scan rates for high resolution monitors. The computer industry has introduced multi-sync monitors, improved standards for colorimetry, perfected compression technology, and reduced the risk of data transmission through advanced error correction. By clinging to many of the outdated elements of NTSC video, the ATSC DTV standard will be blocking the ability to bootstrap themselves into the twenty-first century through the innovations of the computer industry.

In paragraph 35, it is noted that "with required standards, equipment manufacturers cannot compete by offering differentiated products using different technologies. Required standards preclude this form of competition. As such, a primary cost of required standards is loss of variety." This simply is not true of a good standard. If this standard had included any scalability, a single standard signal could be sent to the home where the quality of the image could be determined by the consumer's choice of receiver. For example, those consumers that preferred to save money, could purchase a monitor with a good image but somewhat lower resolution. For the true videophile, an excellent image could be decoded from the single signal. This can only be done with scalability based on layering. With the possibility of eighteen separate and unique signals being broadcast, it is necessary for all receivers to be relatively expensive, as all must decode eighteen signals as opposed to decoding only the pertinent layers of a single signal. With all receivers having the onus of this cost, conventional forms of competition are stymied.

Paragraph 36 requests commentators to discuss the importance of transmission standards. It should be noted that DemoGraFX is completely in favor of proper television standards. Our problem is with the current proposed standard. We feel that it does not properly deal with "the swift transition to regain spectrum and reduce costs." This can only come with a system that properly uses compression technology to its fullest. We feel that our layered approach to compression beats the proposed standard by over 200%, in compressing moving imagery, thus yielding more spectrum for more channels and data delivery to the home. Under the present proposal, the methodology of eighteen separate formats precludes further adoption of a more efficient and less costly approach. Imagine a producer who must decide which of the eighteen formats will give him/her the greatest audience share. Film and video will have to be mastered in multiple formats for different markets. Equipment will have to be produced to convert from one format to the other. With a truly scalable single system, all such works would only have to be mastered once at the highest resolution. Thus saving the producer and the broadcaster, not to mention the consumer hundreds of billions of dollars. With a single scalable and extensible system, the standard becomes much easier to mandate with fewer defections from the standard occurring over time. It is our opinion, given the present proposed broadcast standard and the number of current alternate delivery systems such as digital satellite, the internet, and cable systems, defection from the proposed standard could occur before the standard is implemented. Consumers will be demanding computer interoperability for home banking, education in the home, direct connection to the police and fire departments, medical services, etc. If the current system does not allow for these services, it will not be able to stop the providers of such services from breaking ranks and creating their own more pertinent standards.

3.17. Detailed Comments on Proposal (Paragraphs 37 through 48 of the Notice)

Paragraph 37 proposes to adopt the ATSC DTV Standard. We and a growing community of artists and technicians from a wide variety of American industries implore the commission to not adopt the ATSC DTV Standard. It could strike a crushing blow to the balance of trade, the innovation of the American worker, and burden the U.S. consumer and broadcast industry with costs that are both unnecessary and counter productive. The eighteen non-scalable formats would create a state of anarchy where those foreign companies that already control the consumer electronics industry of America, could further dictate a choice of one format based on what they chose to support in their products. Because these companies already have a heavy investment in interlaced, 60 Hz, non-square pixel, 16x9 aspect ratio video, you can be assured that the "American" standard will be reduced to this single format within a matter of few years. The other formats will be faded and the consumer will be faced with a standard that was not decided by the consumer market, but by the inside corporate cloister of a few foreign consumer electronics manufacturers. It is the duty of the FCC to protect the consumer from such forces, and to look after the best interests of the American people.

Paragraph 38 states that "the digital television system that has been recommended by the Advisory Committee appears dynamic, flexible and high quality." Sometimes things are not what they appear. For reasons that have been previously discussed, the system is not dynamic because it is not truly scalable in its formats. Each format is distinct and a separate signal. Receivers cannot "pick off" that part of the signal that is important to them. Instead, they must decode any and all of the eighteen signals that may be broadcast. This is not a dynamic system, but does require a rather dynamic receiver. The burden is on the consumer and not the standard. In this way, the committee has averted its purpose for describing a single standard signal and instead will force the consumer to purchase an elaborate receiver to decode the compromise of eighteen inflexible formats. As for "high quality", it must be remembered that an interlaced 60 Hz. signal does not supply a sufficiently sharp image for even the size of text contained on this page.

As a rationale for this proposal, the notice states "that even at lower resolutions, the recommended system represents a clear improvement over the current NTSC standard." Of course, many Europeans would claim that PAL offers a clear improvement over current NTSC. Even though NTSC is a very outmoded standard, it would be terrible to only make minor improvements to it, when an Advanced Television standard is possible that could revolutionize the way we perceive television. America could have a television system that could educate both our children and ourselves. A television that could bring the average family's budget under control through financial services. A television that could reduce the impact of national emergencies through direct connections to public services, improve access to financial data, build new industries, and give the small as well as the large American business a foot up in the international market place. We at DemoGraFX are not pleading for just a better system than NTSC, but a system that will greatly improve the life of every American citizen. It is one of our main complaints that the proposed standard looks to the past for ways to improve, rather than looking to the future for ways to innovate.

Paragraph 39 talks of the rare opportunity to increase significantly the efficient use of broadcast spectrum. We support this goal completely, and it is the main reason for objecting so vehemently on aspects of the proposal that deal with compression, scalability and extensibility.

Paragraph 40 deals with "headroom" for innovation. Although the packetized structure of the data transport, does add flexibility that will permit the DTV licensee to provide several standard definition programs or one high definition program, it does not provide for "data transfer or electronic publishing on the remaining bit streams". Nothing but the largest of text fonts are readable on an interlaced 60 Hz. monitor and the error rate proposed would not allow for data transfer as it relates to commerce, medicine, or public safety. This means that a wide array of innovations cannot be introduced without Commission action.

Chapter 41 seeks comments on the tentative conclusion to require the use of the ATSC DTV Standard. We ask that the commission neither adopt, recommend or mandate such a standard. We feel that the scenario described in chapter 42, a scenario that is based on the standard being fully accepted and established may never happen. Both the Entertainment industry and the Computer industry in America stand four square against the proposal. It must be remembered that the Entertainment industry and the Computer industry are made up of many American companies, while America has come close to completely losing the home electronics industry to foreign concerns. We feel that the opinions of those industries that aid rather than hinder America's balance of trade should be given some weight in this all important decision.

The proposal talks of a time when "there will be technological innovation that even the flexible ATSC DTV Standard may not be able to accomodate." That time is unfortunately now! There is no room in the current standard for adopting any of the breakthrough technology that DemoGraFX has produced. As a small business, in many ways, we feel shut out of the process due to the inflexability of the process. We are sure that other small American businesses will also feel that the standard is too rigid and not flexible enough for their company to chance the cost of research and development into innovative new approaches. America already has a terrible history of creative R & D efforts being blocked by rigid standards. Worse still, we have a history of having U.S. R & D breakthroughs being exploited outside our country first, because of a playing field biased by a few powerful foreign interests. We, small American innovators, look to the FCC for opting for fairness in the communication marketplace.

Paragraph 43 expands on this theme. It states that it is important to "adopt rules that encourage further innovation by those who have devised the ATSC Standard, as well as new entrants." We, at DemoGraFX, are one of many of these new entrants that see ATV as a unique chance to bring a better quality of life to the American public, while growing as a company, paying taxes and increasing the common good. We fear that the proposal, however is biased toward those that have devised it. We are not alone in this feeling, and we recognize that you will receive many rebuttals such as this one. It would not surprise us if there was a certain similarity in the responses. We hope that you will recognize the importance of these similarities and the solidarity of the groups that object to the current proposal.

In paragraphs 44 through 47, different options for accomplishing the goals of the commission are given. We would suggest a immediate proceeding to review the proposed standard. This proceeding would include head to head comparisons with other proposed systems such as those that fully use non-interlaced scanning, use square pixels, use higher frame rates, etc. If the ATSC DTV Standard is truly state of the art, then it will succeed in these head to head tests. If it is not, then it will be defeated by better systems.

We also feel that it is very important to listen to the needs of the artistic community, who have created the video and film materials for which America is justly famous. Standards should protect the rights of the artist as well as the businessman. We feel that the standard should discourage such tactics as pan-and-scanning the frame, colorization, and the re-editing of film for broadcast. Understandably, there are first amendment considerations for mandating these artist rights, however, the Standard does have a responsibility as a "bully pulpit" to protect the integrity of the artist's work through discouraging mutilation of the artist's vision.

Paragraph 48 asks for comment on approaches for requiring a standard. Adopting a standard without mandating its use, will encourage alternative media providers to "break ranks" and create their own standards. Multiple standards and formats are costly to produce and to master. It is important that a robust, technically sound standard be in place to avoid the anarchy of such diversity.

Paragraph 49 deals with we critics of the proposed standard. It states that "segments" of both the computer industry and the entertainment industry have leveled criticism at the Standard. These "segments" should not be trivialized. They make up some of the most important corporations and artists in this country. Names such as Apple, Compaq, Intel, Microsoft, and many, many other members of the computer community oppose the current standard. Their opposition is not one of emotion, but an opposition based on the many technical flaws of the Standard. These are not technical "lightweights" but the movers and shakers that have already revolutionized the way America does business, gains knowledge, communicates, and increases productivity. These are the companies from whom foreign consumers buy their products. These are the growth companies that have kept American employment high.

The Entertainment industry also can not be trivialized. Film and video production is one of America's largest imports. Both the American Society of Cinematographers and the Director's Guild of America oppose the current standard. Their members have brought us the art of the twentieth century. They collectively feel very strongly that the current proposed standard will not properly display their work. Steven Spielberg passionately objects to the proposed Standard. Spielberg has consistently brought quality family entertainment to the world. His films are some of the biggest grossing motion pictures in the industry, and his voice is heard strongly and distinctly. When Steven Spielberg takes a stand on an issue his thousands of supporters and admirers take notice. We feel that these men and women that make up the opposition to the proposed Standard represent some of America's greatest and most creative minds.

DemoGraFX fully supports all of the CICATS objections which include:

- No interlace formats should be a part of the standard.
- Refresh rates should include rates greater than 70 frame/second.
- The Aspect Ratio should be reconsidered.
- Colorimetry should be closer to that of film or better.
- Improved data integrity standards should be added.
- Square rather than rectangular pixels should be used.
- Better Interoperability with computers is mandatory.

3.18. Detailed Comments on Acceptability of the ATSC DTV Standard (Paragraphs 49 through 54 of the Notice)

In Paragraph 49 the proponents claim that progressive scan is emphasized in the proposal. In fact, interlacing is emphasized by being an option for all resolutions except for 1280 x 720. Further, the Grand Alliance has only shown interlaced systems at NAB and other public showings. Also, the testing of ATV has been biased toward interlace systems due to analog bias of the testing facilities.

The Advisory Committee has stated that interlaced formats should be migrated to progressive scan "as soon as improvements in digital compression and transmission technology make an over-1000 line, 60 Hz progressively scanned format achievable..." DemoGraFX has already demonstrated a progressive scan system that is 2048 x 1024 at 72 Hz in the current bit budget of 18 mbits/sec proposed.

Proponents state that "computer displays are also available with a wide variety of refresh rates, including 60 Hz." Yet, we know of no computer monitor with a resolution over 640 x 480 that operates at under 70 Hz. Multi-sync computer monitors allow for users to adjust resolutions to best match the optimal resolution for the image. This is done without having to create eighteen formats for every image. Although manufacturers can in theory "provide any display rate or rates they desire" the proposal has a heavy bias toward 60 Hz.

Proponents also assert that bit error rates are inherent in the broadcast environment not the system design. This, simply, is not true. Bit error rates are indeed related to problems in the proposed standard. It is true that error free transmission is an ideal and that modem technology is also burdened by error rates, but in the current proposed standard, the error rate for ATV is above that acceptable for commerce. Modems are presently used by banks and industry for commerce on a daily basis. Retry in case of error is not available in the current standard as it is in point to point networks. So the comparison is not logical.

DemoGraFX supports the American Society of Cinematographers in their desire to be included in discussion of aspect ratios. SMPTE did not include the American Society of Cinematographers input in 1985 and dealt only with 60 Hz interlaced imagery - the 240M and 260M Japanese standards.

It should be noted that it is not in the charter of SMPTE to act as an advocate for any standard, and we feel it inappropriate for the proponents of the ATSC DTV Standard to use the comments of SMPTE members to promote this proposal. If the commission would speak to Stanley Baron, President of SMPTE, we are sure that he would agree with us on SMPTE's neutrality. The quote from SMPTE states that material composed for a 2:1 aspect ratio could be accommodated by leaving 11% of the vertical space unused. However, anamorphic (CinemaScope 2.37:1) films lose a full 25% of their height on a 16:9 monitor. Today, most large budget films are in this 2.37:1 format. This loss in vertical space is enough to tempt broadcasters to use pan-and-scan techniques to further reduce the original image area.

In response to Paragraph 54, the ATSC DTV Standards process was not always an open one. As has been stated earlier, responses to major issues were often restricted to a few comments in question form only. Responses to these questions from the committee were rarely forthcoming. In the many years that the ATSC DTV Standard was given "thoughtful consideration" by the committee, the computer industry developed progressive scan, 70+ Hz, square pixel monitors, excellent compression techniques and ways of securing data from error. Most of these innovations have not been given thoughtful consideration.

We believe that any standard should bare the burden of proof for its viability. Such scrutiny should take place under the eye of the general public. Participants in creating this current standard have a vested interest in the outcome of this process and therefore should be held to the strictest standards themselves. This is a multi-billion dollar decision and therefore the proposal should not be passed solely on the recommendation of a few.

3.19. Detailed Comments on Cross-Industry Interoperability (Paragraphs 60 through 64 of the Notice)

To say that the Grand Alliance plan "is a balance that has been endorsed by, among other, a subgroup of the Federal Government's Information Infrastructure Task Force, the 1994 NIST/ARPA Workshop on Advanced Digital Video, and the Information Technology Council ("ITI")." is very misleading. The ITI in fact is very unhappy that such a statement has been included in this notice. Both NIST and ARPA approve of the idea of ATV but not the current implementation with interlace. DemoGraFX feels that these organizations should again be polled by the commission to verify their current stand on this proposal.

DemoGraFX feels that Headers and descriptors proposed are not robust enough. The MPEG-2 transport layer is very limited. Square pixels and progressive scan are necessities for interoperability. They were treated only as options by the interoperability review panel. What if sound were included but not mandated for interoperability?

Interoperability problems abound with most, if not all, of the ATV formats, including the use of non-square pixels which can distort images, interlacing causing motion artifacts that blur the image, conversion problems that degrade the image, scan rate conversion problems that create beat artifacts, the necessity for 3:2 pulldown methods of transferring film to 60 Hz video which cause erratic movement and beats in the image, unreadable text caused by interlaced 60 Hz receivers that cripple multimedia and other interactive applications, poor colorimetry resulting in inaccuracies in applications where color interoperability is necessary, poor error correction which makes applications dealing with money insecure, etc.

Because of the cost of production and the cost of mastering video and film, it is important to have interoperability between the terrestrial broadcast, cable and satellite systems. If the ATSC DTV Standard limits the capabilities of companies to deliver computer data and services this standard will not be accepted by alternative media. This could result in enormous costs related to producing for multiple standards.

Paragraph 64 states that "B-frames necessarily call for more memory to be installed in the receiver or set-top converter, slightly raising costs." The use of B-frames significantly, not "slightly" raises costs and requires faster processing in addition to more memory. If a temporal layering scheme, as is proposed by DemoGraFX, was used, B-frames could be used for high end systems without financially penalizing less expensive systems.

3.20. Detailed Comments on Receiver Standards and Related Issues (Paragraphs 65 through 66 of the Notice)

A viable alternative to mandating "all format" receivers is to use a layered system. Receivers that, as described in the Standard, must decode an HDTV signal into a SDTV signal will not be inexpensive. Again, a layered system where the receiver only needs to deal with its layer or portion of the signal is more attractive.

Mandating that every receiver must decode and translate all eighteen formats into its own native format will definitely have a large negative effect on both reception quality and receiver costs. A layered system would solve this problem and be a less expensive alternative.

3.21. Detailed Comments on International Trade (Paragraph 68 of the Notice)

Multiple mastering of film and video for the diverse 18 formats proposed would seriously hinder the preserving of our extensive film and video heritage. The cost of preserving multiple masters is prohibitive. Every year we lose hundreds of film and video titles due lack of funds for proper archiving. Multiple formats will only exasperate this crisis

Paragraph 68 states, "We believe that the ATSC DTV Standard is an excellent digital television transmission system, and as stated earlier, there are no competing systems on the horizon." There is at least one competing system on the horizon, in fact it is here now. We feel that the DemoGraFX system, having been developed late in the standards process is being overlooked due to the closed nature of the process and the rush to adopt some standard no matter how flawed. We feel that the DemoGraFX system answers all of the needs of both the Computer industry and the Entertainment industry, and saves both broadcasters and consumers billions of dollars over the cost of the ATSC DTV Standard.

The notice talks of the importance of not creating barriers for American film and video by making them difficult for foreign markets to buy or display. Yet, the reasoning behind 60 Hz. video in the Standard seems to increase the chance for Europe and the rest of the world not to adopt the ATSC DTV Standard.

Both PAL and NTSC are included in the MPEG-2 standard, yet they are both incompatible. Adopting the MPEG-2 transport stream syntax therefore has limited use for insuring international compatibility.

3.22. Detailed Comments on Captioning (Paragraph 69 of the Notice)

In the current ATSC DTV Standard there is no proper specification for the overlay planes and text formats necessary for readable closed captioning. Also, a much more reliable transport is necessary for overlay planes and text.

4.0 Conclusion

In conclusion, DemoGraFX appreciates the time and effort that was expended to create the current ATSC DTV Standard proposal. Unfortunately, the proposal misses the technical mark on too many issues for its adoption. We feel that these oversights come from an emphasis "on creating a standard that does what we are doing now, only better". The true challenge should be not only to improve current television, but to plan the video and information system of the 21st Century. This system would fully integrate computer and video technology, protect the integrity of the artist's work, provide for adequate data security, promote and reward American technical and artistic creativity, stimulate American job production, and, in new and unique ways, further enrich the lives of the American populace. It is to this end, that DemoGraFX, respectfully opposes the adoption of the ATSC DTV Standard.

Sincerely,

A handwritten signature in black ink, appearing to read "Gary Demo", with a long horizontal flourish extending to the right.

Gary Demo, President/CEO

A handwritten signature in black ink, appearing to read "Allan Peach", with a long horizontal flourish extending to the right.

Allan Peach, Vice President Technology Projects

Appendix A
(Letter from DemoGraFX to the ATSC, 18 Feb 1990)

To:
James C McKinney
Chairman
Advanced Television Systems Committee (ATSC)
1776 K Street NW, Suite 300
Washington, DC 20006
202 828 3130
202 828 3131 Fax

cc: Bob Hopkins (ATSC), Virgil Conanan (ATSC/T4S1)

18 Feb 1990

Concerns About The Direction Of The ATSC

I am very concerned that the deliberations of the ATSC are resulting in some very problematic conclusions. I will summarize my concerns briefly:

1) The computer industry is greatly under represented. Only Sun participated in the discussions. IBM, HP, DEC, NCR, Apple and many others were not represented.

2) The film production industry was not represented. There were no spokesmen from Disney, Warners, Universal, MGM, Fox, Paramount, Lucas, etc.

3) Although the current colorimetry proposal contains some excellent CIE color primaries, I believe that the "transfer function" which specifies the video signal is less than ideal. The use of a logarithmic function, which more nearly approximates film density, would allow both color and exposure correction, similar to film. The lack of such color and exposure correction has limited the production usefulness of current video systems, to the degree that most prime-time television production is mastered on film. Since the ATSC has not studied the logarithmic function, I feel that endorsement of the L⁴⁵ transfer function currently proposed is premature.

4) Although there was significant support for 2048 x 1152, including Eureka, the summary document was constructed as if 1920 x 1080 were endorsed by consensus. Letters which I produced from NCR, Disney, Pixar, and R Greenberg endorsing 2048 were ignored.

5) 2048 x 1152 was only allowed to be discussed at 30/60 Hz (29.97/59.94) interlaced. To my knowledge, support for 2048 x 1152 is almost completely for 24/25 Hz progressive. No discussion was allowed of 24/25 Hz progressive.

6) The ATSC is planning to endorse 30/60 (29.97/59.94) Hz interlace at 1920 x 1080, with 60 (59.94) Hz progressive planned for the future. I am

concerned that 30/60 (29.97/59.94) Hz interlace is very problematic for down conversion to NTSC or PAL/SECAM. I do not feel that 60 (59.94) Hz progressive will be available any time soon, since it represents roughly double the bandwidth of currently operating systems. However, I am extremely concerned that 30/60 Hz (29.97/59.94) interlace is totally contrary to the needs of both the film production community and the computer industry.

I feel it is unconscionable that the ATSC would recommend a standard to the State Department which was contrary to the interests of two major healthy U.S. Industries. Both the computer industry and the film production community could be dealt a severe blow by such a recommendation. The computer industry would stand to benefit from a synergy between computer display requirements and emerging HDTV standards. Such a synergy is all but precluded by a 30/60 (29.97/59.94) Hz interlaced scanning recommendation.

The 1920 x 1080 30/60 (29.97/59.94) Hz interlaced recommendation favors analog implementations of HDTV. It is clearly in the best interests of the U.S. computer and semiconductor industries if HDTV standards are conceived as digital standards. The ATSC seems unwilling to confront the question of whether a digital framebuffer should be specified within each receiver as part of the HDTV system architecture. However, nearly every proposal for HDTV distribution systems seems to require such a framebuffer.

The use of a 30/60 (29.97/59.94) Hz interlace standard poses very serious problems for the producers of shows within the U.S. Such equipment is very difficult to use in the post production portion of show preparation. Even more serious, however, is the difficulty that shows created in such a format would be nearly unsaleable to European and other 50 Hz markets. U.S. made shows are currently very popular in Europe. It seems like a very ill-considered idea to propose a standard that would greatly increase the difficulty of using HDTV as a production medium for shows which are intended for eventual international distribution.

The U.S. faces a possible loss of international distribution market share if other countries must utilize production equipment which match the requirements of their own domestic standards, such as down converted 50 Hz PAL/SECAM.

The 30/60 (29.97/59.94) Hz interlace format is also useless for the production of shows which are intended for initial release on film to theatres.

The ATSC has also failed to acknowledge that 2048 x 1152 is a *superset* of 1920 x 1080. By endorsing 1920 x 1080, one is precluding the use of 2048 x 1152. However, an endorsement for 2048 x 1152 allows an easy extraction of 1920 x 1080, much the way a film print is made from a negative. There are legitimate needs for 2048 x 1152, in film production, computer displays, and for 50 Hz down conversion. In general, 2048 x 1152 as a production and mastering format offers substantially more flexibility than 1920 x 1080. The larger format also offers extra border area with which to process the pictures on their way through the production process, and then on to transmission and reception.

I feel that it is equivalent to ignoring the needs of Europe to endorse 1920 x 1080, and therefore I am very skeptical that world-wide acceptance would be

possible for such an endorsement. 2048 x 1152 at 24/25 Hz progressive will support *both* the needs of Europe as well as providing an excellent source for countries desiring 1920 x 1080. I find it puzzling that this benefit was not discussed in the ATSC deliberations.

In general, I strongly encourage a reexamination of the path which is being pursued by the ATSC, in light of its potential negative impact upon the film production and computer industries.

Sincerely,

Gary Demos
President/CEO

Appendix B

May 1991 Testimony Before The Committee on Science, Space, and Technology, Subcommittee on Technology and Competitiveness

Testimony

Committee on Science, Space, and Technology

Subcommittee on Technology and Competitiveness

U.S. House of Representatives

May 21, 1991

Gary Demos

DemoGraFX

Recent HDTV Developments

In the past year, four of the five proposals for High Definition Television being considered by the Federal Communications Commission (FCC) have switched from being traditional analog-type systems to being all-digital systems. The only system not to switch is the system being proposed to the United States by the Japanese National Broadcasting Corporation (NHK).

The change to all-digital is a major improvement in quality. Digital HDTV systems also allow many uses for high definition television beyond the current uses of television. These new potential uses have come to light recently through technical studies taking place within the United States, through taking advantage of new possibilities enabled by digital technology.

At the heart of digital high resolution television proposals is a technique known as "compression". Digital compression allows a high resolution moving image to be stored or sent to viewers using a small fraction of the channel width which has previously been required (prior to one year ago, when the digital systems began to be introduced). This digital compression technology, although it has been developed internationally, was first embraced for high definition television in the United States. Both Europe and Japan had developed their HDTV systems through a political process which prematurely adopted a more traditional television technology. The innovations inherent in the digital proposals in the United States have temporarily given us the lead internationally. We have the lead despite many billions of dollars which have been invested in Japan, as well as substantial investments in Europe.

However, even though we can be proud that four excellent technical proposals for digital HDTV have been developed, these proposals fall far short of what is possible. They do not fall short because the technology is not capable of being extended to take advantage of new possibilities, because it quite definitely can be extended. They fall short primarily because of the original perception that HDTV was only an entertainment medium, and that the only concerned parties were the broadcasters.

We must be cautious that we do not let our steps forward to digital HDTV technology fall short of their potential. Both the Europeans and the Japanese have both a stronger national will to dominate HDTV and a stronger inclination for substantial investment with respect to HDTV, especially in Japan. It can be expected that they will both upgrade to digital technology in the next year or two. In order for our present technical lead to mean

anything, we have to do our best to propel the new technology toward enhancing our traditional national strengths of entrepreneurship, technical innovation, individual creativity, and empowering and educating the individual citizen. We must adjust our view of HDTV as an entertainment and broadcast medium, to understand the full potential that high resolution images can play in everyday life. Such a change of focus with respect to high resolution images as a national resource could give us an international technical and implementation lead which could last for possibly decades.

Worthwhile Objectives of HDTV System Architectures

The current primary methods of video distribution are terrestrial broadcast, cable, and videotape rental distribution. Also in more limited use is direct broadcast satellite reception, the rental of video laser disks, and the purchase of video tapes and laser disks. It should be anticipated that work on a new standard (MPEG) will also result in a possible distribution of video imagery using audio digital disks.

There is a potential for other future ways to distribute moving imagery. These methods will most likely be digital. The FCC examinations of candidate HDTV systems have resulted in all of the U.S.-based proponents for systems recommending digital systems for terrestrial broadcast. However, the digital picture processing (encoding) techniques which they have developed are useful for other digital distribution channels as well.

The "broadcast" method of distributing video is presently in use with terrestrial television, cable television, and direct broadcast satellite. Funding for these broadcast services comes from direct advertising or from "premium movie channel" fees. Video tape or disk rental is a more selective process, where thousands of shows are available for selection. Once selected, the show may be viewed at the renter's convenience. "On demand" on-line viewing is not available except in limited locations with a limited choices of shows.

Broadcast advertising has a problem with effectiveness, since the audience for a given commercial may be mostly inappropriate. For example, I am not in the market for a car, and I don't drink beer. Therefore, all car and beer advertisements which are shown to me are wasted. However, newspaper classified advertisements allow a broader and more detailed selection of used items for sale. A new item equivalent could be quite valuable to a shopper looking for a particular product. Current "shopping networks" suffer from the same broadcast problem, where the item being offered is not one which is currently of interest to the majority of viewers. It would be desirable to improve advertising effectiveness through matching the viewer's needs with the product offerings.

Interactive two-way video communications are not widely available, but rather require expensive dedicated hookups and equipment. However, technology to support such communications is rapidly becoming economically viable. Certainly in the next ten years, the home portion of such communication will be within the financial reach of most citizens, just as the VCR has become widely available. However, the communications infrastructure which would support such interactive citizen-to-citizen communication is neither present nor planned. It is not planned because the

current regulatory environment in the United States precludes the potential providers from offering enough of the appropriate services to make the investment in this infrastructure attractive to them. Therefore, our current regulations deny the proper framework for building interactive visual communications.

Since HDTV is likely to be a new type of digital technology, the development of HDTV affords us an opportunity to design the entire architecture for national interactive visual communications.

Interactive visual communications require an infrastructure similar to the current telephone network. However, in addition to small conference calls and person-to-person calls, a visual presentation might be usefully viewable as "receive-mostly". Examples would be a class lecture, which might have thirty viewers, where the teacher and blackboard are visible on a high resolution screen. In addition, students asking questions should be able to be seen by other students. Thus, the majority of the imagery comes from the teacher, but occasional additional views are useful.

Although there are several methods of providing interactive visual communications, fiber optics is certainly the leading technology. HDTV digital signal designs should be appropriately constructed so as to allow many high and medium resolution picture streams to share a single channel. In addition to some necessary channel sharing, a general switching technology, similar to current telephone systems, would also be required. An HDTV system architecture which is conceived in this broader context would have substantially more social benefit than a system optimized for a single type of broadcast distribution.

Communications Infrastructure

It would benefit the United States in global competitiveness if the HDTV system architecture also provided a framework for a national communications infrastructure. It would be desirable for many regions of the country which have high unemployment rates to be able to provide a proper work support environment for able-bodied citizens of those communities. The current requirement that each person must live in the proximity of the workplace causes great hardship when factories close and regional income declines. However, if there were to be an ability to interact with professional and even blue-collar colleagues at a distance, the degree to which resources would have to be concentrated locally would be reduced. Many professionals travel a great deal, with a substantial amount of their time being wasted during the often tedious travel process. Further, when professional travel becomes a constant way of life, the family life can suffer severely, especially to the detriment of children. Even within major metropolitan areas, affordable and desirable suburban housing is often far enough from the workplace that one, two, or even more hours per day are spent in crowded commuting, which is again a waste of talented human abilities. These distance barriers are a fact of life, and have a direct effect on the gross national product, and on the quality of daily life for our citizens.

Expert human resources are often not located near a workplace which can use these resources, thereby resulting in people accepting lesser jobs where they are not making their largest contribution to society or to themselves. The

number of specialist experts in many fields is less than one hundred people in the entire nation. As society continues to become more complex and specialized, we will experience more of the phenomenon where a small number of experts in a given field are located predominantly away from the regions where they are most beneficial.

An appropriately designed HDTV architecture could provide a mechanism to connect the talent with more optimal employment, for the substantial class of jobs which can operate with good remote visual communication. Teleconference meetings, whether with a group or just with a boss and a colleague, can potentially provide the interaction which now is only possible by working at the same location. Further, the ability to excerpt the meeting images for communication to colleagues in the form of "video mail", can potentially enhance productivity the way that Fax and answering machine (voice mail) technology has improved communication. The personal computer, fax, and the inexpensive copier have allowed a small proportion of our citizens to earn a living from their homes, and has allowed some of them to live in rural areas. With a more generally accessible display, which is designed for person-to-person interaction and is designed to support teleconference meetings, it is possible to substantially increase the number of people who can earn a living at home or at a remote office because of the development of such technology.

Improved information access, in general, is a very valuable piece of infrastructure to benefit the United States. Educational access to study aids, encyclopedias, news archives, and technical journals from a home or office can be very beneficial. Current libraries with sufficient size to provide significant technical and educational resources are often located at some distance, and usually require hours of time being dedicated to searching for appropriate information. Many libraries are difficult to use, and frustrating in their incompleteness. A user of an electronic library potentially need never find a key book or article was "checked out", as the culmination of a long and possibly tedious search. Eventual aids will be developed to ease the process of searching for relevant "jargon-free" articles and information, and even for accessing investigatory video magazines (like CBS's "60 minutes", PBS "Nova", or CNN's "Future Watch").

Even more significantly, training in new jobs for workers in regions with declining economies might be provided by firms which need these workers enough to provide appropriate training media. Literacy in written and spoken English could be improved by access to appropriate materials. Even easy access to learning other languages could be provided.

Local or regional political access to candidates, ballot issues, and access to the arguments pro and con is also a potential use of a visual HDTV communications infrastructure. Neighborhood safety, through improved communication with local law enforcement, neighborhood issues, such as proposed zoning changes or development proposals, and other issues of interest to the residents of a community could potentially be enhanced. Voting itself could someday be done via the system, much the way personal computers can do banking in addition to automated teller machines and bank personnel. Voting turnout and voter awareness on issues would certainly increase with improved access to the meaning of the issues, familiarity with the candidates without having to be glued to the television and newspaper, and to the voting process itself.

Adjustments to HDTV Ideas

One valuable and feasible attribute of HDTV systems would be the ability to extract lower-quality images off of the main high quality HDTV signal. This is possible with a small adjustment to the current digital HDTV systems. Such a lower resolution image could be useful for hand-held and mobile communications. A lower quality picture could be received on a much lower cost receiver. This would allow our citizens to afford a higher quality picture than NTSC video, but without paying for the highest quality system. A lower resolution extracted image would also be useful as an "insert window" on high resolution screens, sometimes called "picture-in-picture". This idea of supporting lower and higher resolution images in the same signal is called "scalability", or an imagery "hierarchy". It is also called a "compatible family of formats".

None of the current proposals before the FCC has this property of scalability. The HDTV proposals for terrestrial broadcast have been optimized solely for a single standard, without any ability to scale resolution or frame rate. Frame rate is the speed at which images are updated on the screen. The HDTV proposals for terrestrial broadcast which are before the FCC all operate at 59.94 images per second, like current (NTSC) television, which optimizes only for sports coverage. The major broadcasters in the United States are most concerned with covering sports and special events with their broadcast, where fast motion is a crucial aspect of the image. However, motion picture film, operates at 24 frames per second, and also makes up a substantial portion of the images presented on current television. High definition television will be presenting a large proportion of shows which are made on motion picture film, which include not only movies, but also prime time television shows, 80% of which are made on film. Motion picture film inherently has the higher resolution that high definition television will be able to produce. The proportion of news coverage where an anchorperson is being shown, is also low in the amount of motion, and could also be at a low frame rate.

In addition to supporting lower resolutions and frame rates, it would also be worthwhile if future advances in picture quality were considered, so that continuing improvements in technology could be incorporated into the HDTV systems and signals. Thus, as better cameras, displays, recorders, and compression techniques became available, it would be nice if these improvements could be applied to the HDTV signal without having to replace the entire system. This is called "extensibility". The ability to extend the system into the future as technical advances occur.

Another desirable attributed of future HDTV systems would be an ability to provide higher resolution for motion picture film than for sports. The current HDTV system proposals before the FCC operate at a constant resolution at 59.94 images per second. These systems, although some of them improve their compression techniques for film, do not improve resolution for motion picture films. Motion picture films, which comprise 80% of prime time television shows, and nearly the entirety of many premium cable channels, operate at 24 frames per second. Any television system which operates only at 59.94 images per second, wastes 2.5 times the quality available for motion pictures. It would be desirable if HDTV systems could offer higher resolution for the best quality signal, when showing 24 frame per second motion picture

film. Since the bulk of high resolution imagery in existence in the world is motion picture film, this should be an important consideration.

Further, the United States has a trade surplus in the motion picture industry, and it is therefore worthwhile to make any HDTV technology which is developed useful to the production of motion pictures. Unfortunately, 59.94 images per second systems are not very useful in the production of motion pictures at 24 frames per second. Those systems which propose interlaced HDTV, are even more difficult to apply to film production.

Interlacing is the technique of showing alternate scan lines during each 60th of a second "field". This technique is in use in the current television format of NTSC, which was conceived around 1940, and is being proposed by some for HDTV. However, the technique of interlace is incompatible with both film production as well as computer displays.

New "multi-media" computers are being introduced in 1991 by all major U.S. computer manufacturers. These computers can display video on the screen in addition to the present types of computer screens. None of these computers can make use of displays which use interlace. Thus, the NTSC television must be converted to non-interlaced format before being displayed on computer screens. HDTV proposals before the FCC which use interlace will similarly have to be converted in each multi-media computer which displays them. Further, this conversion impairs quality. Interlaced HDTV systems, therefore, add cost and reduce quality. Also, since digital HDTV systems are more similar to computers than to television receivers, interlace can be seen to have been more appropriate to non-digital (analog) HDTV systems.

Another issue involved in computer display compatibility is the need for computer screens to refresh at rates higher than 59.94 images per second. There is a general trend to refresh rates above 70 images per second. This higher refresh is needed when the HDTV images are viewed in a bright lighting environment where the eye is more sensitive to flicker. A typical office, factory, or library environment, where there are bright fluorescent lights, will need these higher rates. Also, the larger screen of HDTV, with its wider field of view, is more likely to stimulate the flicker perception of the eye from the sides of the screen. The "peripheral vision" of the eye, to the sides of where a person is looking, is much more sensitive to flicker than the center of vision. Thus, larger screens need higher refresh rates in order to appear flicker-free. Even in the home environment, high definition displays might be bright enough to view in the daytime with the curtains open, as are many recent large screen television sets. Flicker becomes more important in these high-light-level environments. This becomes especially significant when considering spending many hours in front of a large screen display. Screen flicker from a large screen over a long period of time can result in Nausea.

Alternative Channel Sizes

The FCC HDTV examination process is focusing exclusively on a 6MHz terrestrial channel with its attendant noise and ghost (multipath) problems. Alternate channel sizes, both larger and smaller, with differing degrees of noise immunity, might also be useful for one or more HDTV formats. Satellite and cable systems can potentially use wider channels. Numerous narrow channels are potentially available as well, although the HDTV quality of a

lower level of resolution or a lower frame rate will probably be more appropriate for channels narrower than 6 MHz. The ability to provide the best quality of picture signal for a variety of digital channel bandwidths is a desirable feature of an HDTV architecture.

Also, it would be useful to have the ability for a given HDTV signal to be able to interact with varying channel loads when sharing a channel with other HDTV signals. This is sometimes called "graceful degradation". Digital HDTV designs are naturally somewhat "elastic". The HDTV proposals before the FCC do not exploit this elasticity, with the exception of one proposal which was developed to be compatible with ISDN, the telephone digital signal standard. When a channel is heavily loaded with many simultaneous picture streams, it would be useful if each picture stream were still the best that it could be within its reduced allocation of data bandwidth. When the channel is lightly loaded, it would further be useful if the high definition images using the channel could expand to provide maximum quality during the light load conditions.

Such considerations optimize the use of communications channels. The HDTV digital signal structure must accommodate such techniques, however, and this has not been the case with most of the current proposals.

International HDTV Standardization

Another valuable potential attribute of HDTV system parameters would be an ability to easily exchange images internationally. The current proposals before the FCC are designed with a relationship to NTSC, the current television standard, but do not have an easy conversion relationship to PAL and SECAM, the standards of Europe and Asia. In Europe, the resolution 2048 x 1152 is being considered, since 1152 is twice the number of scanning lines of PAL and SECAM. The proposals of 1035, 960, and 720 active lines which are before the FCC inhibit convenient international program exchange.

Also, the numbers 2048 and 1024 for the horizontal picture resolution are seen by many as a natural values for compatibility with computers, whereas 1920, 1440, 1408, and 1280, which are the numbers before the FCC for terrestrial broadcast, are all less than ideal in digital systems, although 1280 is the best of these numbers.

Enhanced Definition Television

The enhanced definition television proposals, based on enhanced wide-screen NTSC, are analog transmission techniques which involve some amount of complex processing. These systems also are less than ideal for international program exchange, as well as being basically incompatible with potential digital uses of HDTV. The pursuit and adoption of these enhanced definition television proposals, one of which is now before the FCC, would not benefit any of the issues being discussed. Enhanced definition television is a technological dead-end. It would be better to stay focused on the HDTV standard design for the United States, and attempt to improve the current designs to allow these important uses other than just broadcast.

The FCC HDTV Review Process

Digital technology is advancing very rapidly, and is now crossing the threshold of capabilities for processing high resolution moving images. These technology changes require that technical development and testing be continually updated to reflect the current state of technology.

The technical testing process which is underway at the FCC was developed long before the four domestic proposals switched to digital technology. The testing process, therefore, was not conceived with the potentials for digital technology in mind. This one issue alone recommends a review of the testing process. Further, the testing process treats the HDTV processing equipment as "one unit". This precludes the examination of the various portions of the technology within the HDTV processing systems, which should be tested individually for quality, flexibility, and capability. The process of evaluating each portion of the system for its merits is much more likely to yield results where portions of a system are found to be applicable to all uses, and can therefore be accepted. This would also allow other portions of the HDTV systems, which may be too inflexible, or which may not produce optimal quality, to be adjusted in isolation, without having to re-test the entire systems.

The FCC process is reviewing five HDTV proposals for terrestrial broadcast. However, there is little or no consideration of other delivery or use of HDTV other than terrestrial broadcast using a standard (6 MHz) television channel. It seems evident that the large number of higher quality channels available via cable and direct satellite reception may be better ways to deliver high resolution imagery than is the terrestrial broadcast antenna. It is my opinion, although it has yet to be demonstrated, that digital terrestrial broadcast will be made to work well. However, the problems of area broadcast coverage from centrally located antennas, with attendant ghosts (multipath), atmospheric disturbance and noise, airplane flutter, car ignition noise, etc, result in the most severe test for delivery of HDTV. The wider, cleaner, and fairly plentiful channels available through cable television delivery, and direct broadcast satellite reception in rural areas, makes a much easier environment for the delivery of HDTV. Fortunately, the current digital HDTV proposals are all very suitable for both cable and satellite distribution at 6 MHz, the same channel size as current television. However, adjustments should probably be made to these systems to make use of channels of other sizes, which are available both from satellite and cable.

There is also no consideration in this HDTV testing process for efficient use of HDTV digital signals when sharing a long-haul fiber or microwave channel, as are commonly used in telephone distribution. Such fiber and microwave channels have very large capacities for carrying signals, which far exceed the capacities of current television channels at 6 MHz. Digital fiber optics, in particular, can be economically routed to every home and business, to provide individual two-way and teleconference access to high resolution moving imagery signals. The FCC process is not weighing the effects of the digital HDTV system designs when they are used on fiber optic connections.

In ten or twenty years, when the HDTV system is fully deployed, and is a part of everyone's everyday life, it is likely that fiber optics will be the primary way in which HDTV signals are sent and received. Cable, satellite, and videotape may be used more to exchange HDTV pictures than terrestrial broadcast reception from an antenna. If terrestrial broadcast has the substantial

possibility to become the least favored mode of reception, why should it be the focus of our technical evaluations?

It is possible that the majority of use of the high resolution display would involve work, education, interaction with colleagues and friends, and exploring new issues and ideas. If such becomes the case, then the exclusive focus of the HDTV system testing on terrestrial broadcast usage for news and entertainment, would also be quite inappropriate.

There has been no provision in the testing process for rating the ability to exchange the HDTV formats internationally. This is evident because all five systems are not very compatible with distribution in Europe. The four digital systems are very closely tied to current NTSC television, which is similarly incompatible with Europe.

The FCC testing process is not considering the usefulness of the HDTV standards under consideration for the production of motion picture film. Certainly if these HDTV formats are not useful to the motion picture production community, they will find little use other than sports coverage. Film would continue to dominate production for motion pictures and television, which is fine, but it provides no advances for the industry in the United States. It is also questionable the extent to which these HDTV proposals to the FCC are being examined with respect to suitability for high definition video production.

The FCC testing process has no provision for measuring whether the HDTV systems are scalable, extensible, or compatible with the broader range of uses being discussed. The testing has focused on the single broadcast use, with no interaction and a single resolution and scanning rate. The testing process is also not planning sufficiently broad testing of the proposals, because tests can be easily devised which will rule out the three interlaced proposals, leaving the two progressively scanned (non-interlaced) system proposals remaining. Further, since no system is taking advantage of higher resolution for the 24 frame per second film rate over the 59.94 frame per second rate of sports, no system is going to be able to demonstrate any advantage for film. The fact that this is not being tested is indicative of the very heavy broadcaster bias of the proposals which are currently before the FCC.

Since no proposals offer any picture scanning rates other than the 59.94 images per second favored by broadcasters, all other needs for alternative image rates are being ignored. Since 24 frame per second film is important, this should be at least one of the rates in a family of rates which are needed. Because of the requirement for computer displays to have rates higher than 70 images per second in order to avoid flicker, 72 displays per second may be a good choice, since it bears a natural relationship to 24 frame per second film, being exactly three times. Use of the rates of 24 and 72 images per second, along with 59.94, which is very near 60 frames per second, would make a much more useful HDTV set of image display rate formats.

The Need for HDTV to Serve Many Uses

The ability of an HDTV signal to operate with medical imagery, educational material, pages of text from a library, legal documents, computer images, fax pages, color photographs, scientific and engineering drawings, etc., would be clearly beneficial to the United States economy. Current HDTV proposals

before the FCC do not provide for these capabilities, and even prevent them to varying degrees. However, these proposals could be modified somewhat in order to allow these capabilities. HDTV, has the potential to have sufficiently high resolution imaging capabilities to allow access to photographs, drawings, and pages of text. Current television cannot show a readable page of a magazine, but high definition television imaging can make such a page readable. It would be unfortunate if such a capability were ignored.

The ability to work collaboratively with colleagues in meetings via teleconferencing would clearly be beneficial. Such conferencing would be even more useful if could operate internationally. This capability also has not been provided by the current proposals before the FCC, although they contain many of the ingredients necessary to allow such conferencing and person-to-person meetings at a distance.

There is a potential for enormous usefulness for HDTV for the production and optimal presentation of motion pictures. However, none of the current proposals before the FCC are useful for motion picture production, and they are also less than optimal for the presentation of our large national library of high quality motion pictures. Adjustments to the HDTV system designs could allow them to be useful, however. Since the motion picture industry provides a trade surplus, and is still mostly owned within the United States, it would be in our best interests to adjust the design of HDTV to allow it to be useful to this important industry. It is also in the public interest to provide the best possible presentation of motion pictures, which have inherently high resolution.

The current HDTV proposals before the FCC have been optimized for the needs of the broadcasters. Although the broadcasters are a very important group, their needs should be met in addition to serving the public interest, rather than to the exclusion. Broadcasters needs can be met within an HDTV design which also meets all of the other needs and uses discussed here. It would benefit us all if the broadest spectrum of citizens were to be served, with benefit to their education, health, and workplace. HDTV must not be viewed as only an entertainment and broadcast news medium. It is a potential vehicle by which the United States can greatly improve the quality of life and economic stature of our citizens within a very short period of years.